Foreword

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I first became aware that there were special problems in teaching science at a distance some forty years ago when Charles Wedemeyer asked me to write (in those days on a typewriter to be delivered by surface mail) to a selection of distance teaching institutions around the world. What he wanted to know was what solutions, if any, they had found to the problem of enabling people who studied at home to undertake scientific experiments as part of a distance learning program. One of Wedemeyer's core beliefs was that if teachers applied enough creative intellectual effort, any learning outcome that could be achieved in a classroom should be achievable outside also, and he would not accept the popular assumption that people who studied at home, usually in their spare time, could not study science simply because they should have to undertake experiments. The question was not if it could be done, but how best to do it, and particularly, how to accommodate the need for experiences that were usually undertaken in a laboratory. In his Articulated Media Project (Wedemeyer & Najem, 1969) he had already come up with one answer to this particular problem, in the form of mobile laboratories that traveled around his state, an idea based on what he had heard about a common practice in the Soviet Union, where laboratories for distance learners were shunted

around the country on railway trains. Looking for a simpler and less costly solution, my assignment was related to his work on the concept of the home experiment kit. This would be a package of materials and equipment that could be loaned to the student, who would use it in conducting science experiments at home. It was one of many ideas that Wedemeyer had been discussing with friends in the United Kingdom who were in the process of setting up the Open University, where it became extremely successful as sophisticated and ingenious home experiment kits were developed on an industrial scale (see Chapter 10).

Forty years after those early initiatives — and in spite of the example of the Open University, which has not only shown that science can be taught at a distance, but has become a world center of high quality science — the prejudice that science can only be taught face-to-face is still widespread, especially in the United States. Indeed, innovative course and program proposals frequently fail to get off the ground because of very ill-informed assertions by classroom teachers that distance teaching of science is not possible.

It should be a matter of some surprise — now that we have Dietmar Kennepohl and Lawton Shaw's book before us — to realize how long it has taken for someone to produce a book to challenge this prejudice, indeed to begin to describe the problem and to document some of the ways in which it has been tackled. Further evidence of the slowness of the educational community to deal with the challenge — and opportunity — of distance teaching in the sciences is provided by the number of articles that have appeared in the quality research journals. In more than twenty years, the *American Journal of Distance Education* has received only one publishable research-based article having "science" in its title; this was an article on the subject of science teaching in high schools (Martin & Rainey, 1993). Added to this, there have been descriptive, i.e., non-research based reports, in the Journal's "Grassroots" section describing isolated experiences in science teacher education (Jaeger, 1995), and another about an attempt

to deliver a biology laboratory (Naber & Leblanc, 1994). A recent research article (Abdel-Salam, Kauffmann & Crossman, 2007) reports an experiment to provide laboratory experiences in engineering courses.

Given this dearth of information, the arrival of a whole volume on the subject of science education at a distance is an extremely important event. The book is not a final answer to the challenge of science teaching, and of course none of its contributors would imagine it to be so. (Personally, I would have liked the editors to have found more evidence about the use, or potential use, of virtual reality as a powerful alternative to the real-world laboratory; it is presumably a topic that will follow as this book inspires others to experiment and report on their progress in this approach.) The book is, however, an excellent overview of the state of the art, revealing where we are today, and pointing to the problems and opportunities now opening up to us, especially the opportunities for using, as I have just indicated, Web 2.0 technologies. As such it provides an excellent foundation for teachers, researchers, and students who are preparing themselves to come to grips with the exciting opportunities in this field.

The book provides the global perspective, the editors having searched globally for their contributors — as indeed in such a neglected area they would have to. Thus, while the majority of contributions come from their own Athabasca University and Australia's Monash University, these are complemented by experiences from other North American universities, from Israel, Bangladesh, the University of South Pacific, and the United Kingdom. Represented here are physicists, biologists, and chemists, an astronomer, a microbiologist, and a geographer, among others. All of course, are engaged in teaching their subjects, but — and this is the core strength of the book in my opinion — they have been well complemented with a team of *educational* scientists, people who I am fairly sure are like me in knowing little or nothing about biology, chemistry, or physics, but who know quite a lot about how people learn and

how best to teach them. In this regard, I was very impressed by the editors' forthright explanation of the reasons that teaching science at a distance has been such a neglected part of the field of distance education, particularly the fourth of their five points. But all five bear repeating; they are: first, that it is particularly challenging to construct an effective learning environment for the study of the sciences; second, that science teachers suffer as do others from lack of resources, combined with the expectation of their employing organizations that they teach at a distance in the same "lone-ranger style" they use in the classroom; third, that the literature that might inform innovators in this area is hard to find, being scattered in a variety of both scientific as well as educational journals; and fourth, and perhaps most difficult to cope with, the educators of science students at post-school levels invariably bring very strong disciplinary and research backgrounds to their teaching but have no training in teaching or in-depth study of the philosophies and methods of teaching and learning; finally, there is the problem of providing laboratory experiences that I have already referred to.

Based on this analysis, the editors have brought together a team of teaching and learning specialists to complement the experts in the disciplines. By so doing they have provided a series of responses to the problem of teaching science that is based on pedagogical theory and research, which helps move the quality of analysis and then the level of debate several steps beyond anything we have seen on this subject until now. I particularly enjoyed seeing the first chapter deal with the challenge of managing instructional development teams. What a revolution in the quality and efficiency of distance education there would be if we could move from rhetoric to reality in the application of the team concept in course design and delivery! The book goes forward then with leading experts on the subject of interaction and dialogue revisiting and developing this relatively well known part of the field, though here very interestingly approached through the lenses of the specialists in teaching subjects that have not always, until recently, been seen universally

as lending themselves to a constructivist pedagogy. The big question, of providing laboratory experiences, is the subject of a full section, in my opinion one of the core questions in this book, and then a final section deals with some issues of the logistics and infrastructure of program delivery.

This book will, I hope, be read by everyone with an interest in education. This is not only for science educators or distance educators alone. Certainly one hopes that teachers of science in the classroom — most of whom are likely to be called on in the future to teach at a distance at least in blended learning conditions — as well as those who already do teach at a distance, and also the administrators and policy makers who have to allocate and manage the resources that are available for science education will study this book carefully and glean from it some of the valuable ideas it provides for the expansion and improvement of distance education in the sciences. Surely our students deserve better programs, the out-of-school population needs more opportunity of continuing education in the sciences, and society deserves and needs a better return on its education and training investment in the sciences than it has enjoyed until now.

If this book goes even a short way toward sensitizing these populations to the challenges of teaching science at a distance and also the enormous potential for society and the individual of upgrading our response to that challenge, it will indeed prove to be a most important work — besides being a thoroughly enjoyable read.

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